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Shaft Mounting 2/prts

The present invention concerns a pneumatic actuator with the features of the preamble of claim 1.

Such an actuator is prior art from German utility model G9014487.2. In prior-art actuators, the drive shaft is mounted in the housing with two end brackets. The end brackets are inserted into the housing from the inside that forms the cylinder, and the shaft is also fixed in an axial direction from the inside with exterior lock washers or snap rings. Installing the bearing and the lock washers from the work area of the cylinder is a rather difficult manual job which gives rise to undesirable costs.

It is therefore the problem of the present invention to improve a pneumatic actuator so that the shaft and pistons can be more easily installed in the housing with fewer required parts.

This problem is solved with an actuator that has the features of claim 1.

Since the invention provides that the piston fixes the shaft in its axial direction by means of a keyed fit, the shaft can move axially until the piston is inserted and hence be moved into its position without additional fasteners. As soon as the piston is inserted, the positive engagement fixes the shaft axially which is brought about in the state of the art by means of the end bracket and snap rings.

A particularly simple embodiment results when the shaft has at least one peripheral groove that engages with a segment of the piston running in an axial direction. When the shaft also has two bearing areas that form the areas where the shaft has the largest diameter, the shaft can be easily guided from the outside into the housing and fits and the area of the bearing sites. Separate bearings are essentially dispensable when the shaft is mounted directly in the housing at two bearing sites. The shaft is mounted with minimal force when the bearing sites of the shaft essentially have the same diameter and thereby

eliminate pressure in both directions. This also increases the length of time the shaft remains fixed at the segments and grooves.

It is particularly easy to create the groove when manufacturing the shaft when the groove is a peripherally cut groove. A symmetrical arrangement that allows the use of two identical piston results when each piston has two segments neighboring the teeth. In addition, the working area at the bearing sites of the shaft can also be sealed from the exterior by means of sealing rings made of rubber or plastic lying in a shaft groove.

A particularly advantageous method to mount the described actuator results when the shaft is first inserted into the bearing sites and then the piston(s) is engages with the shaft so that the shaft is fixed in an axial direction without additional fasteners and, in particular, is held in the bearing sites.

An exemplary embodiment of the present invention will be described in the following with reference to drawings.

Shown are:

Fig. 1: A cross-section of an actuator according to the invention following the axial direction of the shaft viewed in direction of the lengthwise axis of the cylinder; and

Fig. 2: A cross-section of an actuator following the lengthwise axis of the cylinder. The perspective coincides with the axial direction of the shaft.

Fig. 1 illustrates a pneumatic actuator according to the invention with a housing 1, a shaft 3 mounted in the housing that rotates around an axis of 2, and two pneumatic pistons 4 and 5. The inside of the housing 1 forms a cylindrical hole 6 in which the pistons 4 and 5 are inserted to form a sealed working area. The lengthwise axis of the hole 6 is perpendicular to plane of projection.

The shaft 3 is essentially rotational symmetrical and has the following sections from bottom to top in Fig. 1:

The bottom end of the shaft forms a bearing area 10 that also represents the site where the shaft 3 has greatest diameter. Abutting bearing area 10 is a cut groove 11 with a boxlike cross-section. Adjacent to the groove 11 are teeth 12 like a pinion with teeth flanks parallel to the axis 2. The top end of the teeth 12 in turn abut a peripherally cut groove 13 that neighbors a bearing area 14. The bearing area 14 of the shaft 3 is also flush with the outside of the housing 1 like bearing area 10. On the top end of the shaft 3 in Fig. 1 is a conventional dihedron 15.

The pistons 4 and 5 as represented in Fig. 1 are cut where they engage with the shaft 3. At this area, the pistons 4 and 5 have outwardly projecting teeth 20 like a pinion that mesh with the teeth 12 of the shaft 3. The axial edges of the teeth 20 each abut a segment 21 that is formed as a single piece with the pistons 4 and 5, and that engages in the grooves 11 and 13. The housing 1 has a through hole that runs in the direction of the axis 2 and that vertically intersects the middle of the midaxis of the cylinder 6. This hole forms bearing sites 22 that, together with bearing sites 10 and 14 of the shaft 3, form a friction bearing to rotate the shaft around the axis 2 . In the area of the bearing sites 22, the interior of the cylinder 6 is sealed from the atmosphere with sealants (not shown) such as O-rings.

Fig. 2 shows the actuator from Fig. 1 in a cross-section along the axis of the cylinder 6. The axis 2 of the shaft 3 is perpendicular to the plane of projection in the drawing in Fig. 2. The same components have the same reference numbers.

Fig. 2 illustrates how the pistons 4 and 5 symmetrically surround the shaft 3. The pistons 4 and 5 bear sealing piston heads 30 that interact with the cylinder 6 and that abut the pinion-like area with the teeth 20. Plate-like cylinder heads 31 seal the housing 1 at the faces of the cylindrical hole 6. The pistons 4, 5, the cylindrical hole 6 and the cylinder

heads 31 thereby delimit a total of three working areas 32, 33 and 34 of which working areas 32 and 34 have a pneumatic parallel connection, and working area 33 can independently receive pressure. Corresponding connection holes for working areas 32, 33 and 34 are identified with reference numbers 35, 36 and 37.

In practice, the actuator under consideration is mounted by first inserting the shaft 3 along the direction of the axis 2 into the housing 1, or more precisely, into the through hole with the bearing sites 22 until the position in Fig. 1 is reached. Then proceeding from the open ends of the cylindrical hole 6, a piston is inserted on each side of the shaft 3 so that the teeth 20 engage with the teeth 12. At the same time, the segments 21 that run parallel to the teeth 12 engage in the grooves 11, 13. The pistons 4, 5 are then pressed symmetrically into the hole 6. This rotates the shaft 3 on its axis 2, the teeth 12 and 20 engage with each other, and the segments 21 slide in the grooves 11, 13. The positive engagement of segments 21 in the grooves 11, 13 fixes the shaft in the direction of the axis 2 without additional fasteners being required. The cylinder 6 is sealed with the cylinder heads 31 and provided with the required pneumatic connections.

When the actuator is used, working area 33 (for example) is supplied with pressure so that the pistons 4 and 5 are pushed apart. In the drawing in Fig. 2, this causes the shaft 3 to rotate counterclockwise while the working areas 32 and 34 are vented. For the shaft 3 to rotate clockwise, the working areas 32 and 34 are supplied with pressure while working areas 33 is vented. This method is known from the state-of-the-art.

It is preferable for the grooves as portrayed in this exemplary embodiment to abut the side of the teeth 12, and for the pistons 4 and 5 to each have two segments 21. The outer edge of the segments 21 slides to contact the outer walls of the grooves 11, 13 during operation, while the segments 21 are at a slight distance from the teeth 12. The shaft 3 is only guided axially during operation by the flanks of the pistons.

In the present case, the preferred materials for an actuator according to the invention are aluminum for the housing 1 and the shaft 3, and plastic for the pistons 4 and 5. The seal

at the bearing sites can be attained by self lubricating plastics. Other materials or combinations of materials are equally conceivable, however. The bearing only receives a small amount of stress during operation since it is an actuator as used for actuating valves.